

Update on Xsuite modelling of BT

John Salvesen, Nikita van Gils



BTe BTp lattices in Xsuite

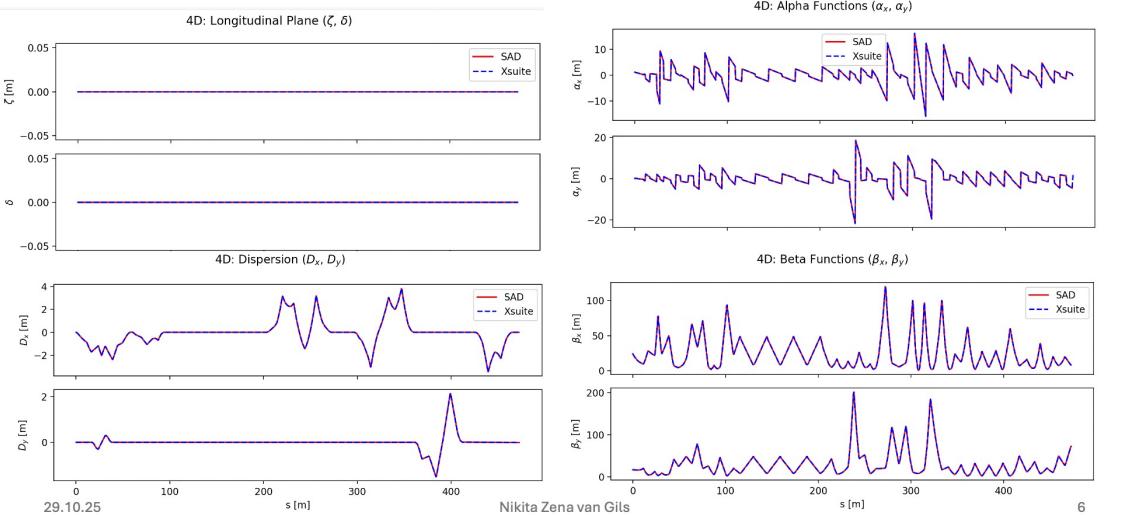
Lattices were converted to Xsuite using the SAD2XS converter (J. Salvesen)

- Converter publicly available on Github (<https://github.com/jpts2/sad2xs>)
- Also available on PyPI

BTe Xsuite Status

Benchmarks in **4D** show excellent agreement

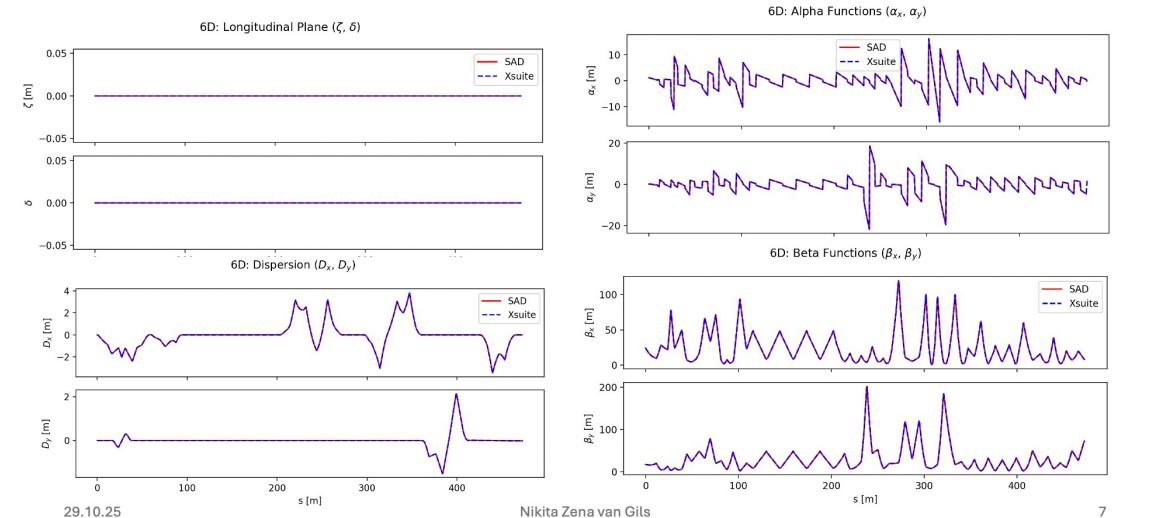
- No rematching required



BTe Xsuite Status

Benchmarks in **6D** show excellent agreement

- No rematching required



Where are we at with BTe?

BTe (with new ECS) in Xsuite has been compared to SAD (files received from Morisan) in 4D and 6D with excellent agreement between the two (4D,6DTwiss & Track)

We obtained a tracked beam from LINAC to the entrance of BTe by Andrea A. (thank you!) with wakefields.

We then used this as input distribution into BTe

As a first step: the beam was then tracked to end of line and compared to MA/DA of HER to estimate injection efficiency.

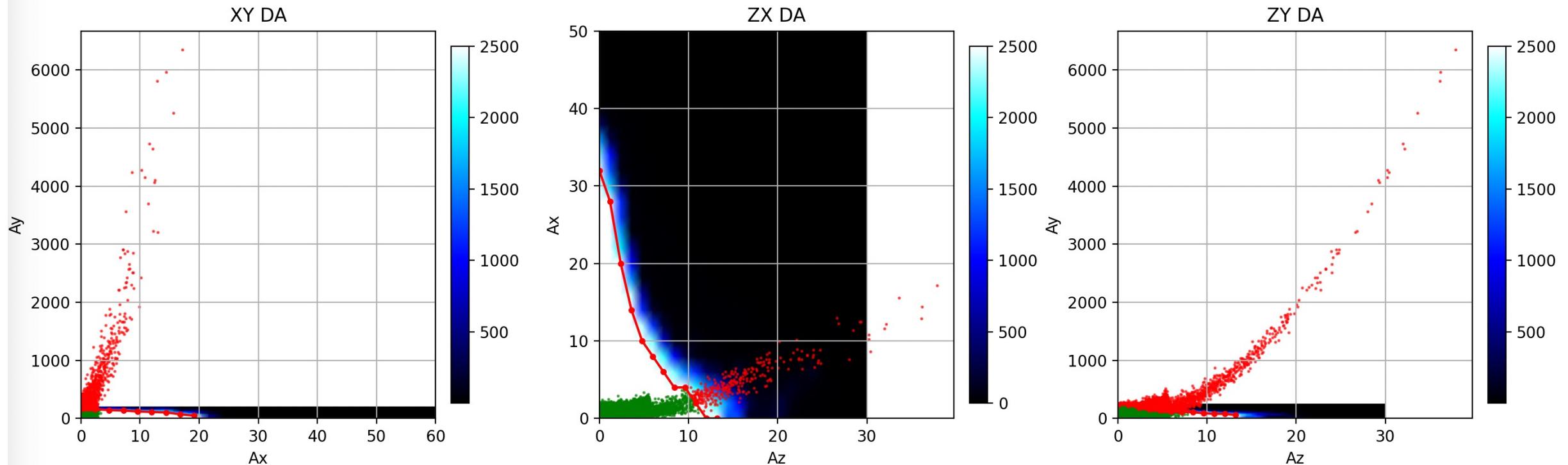
NEXT STEP: take septum magnet into account in terms of acceptance into ring (injection efficiency). May need to do coordinate transformation to compare

Some sanity checks

Does the ECS off cause any change in delta?

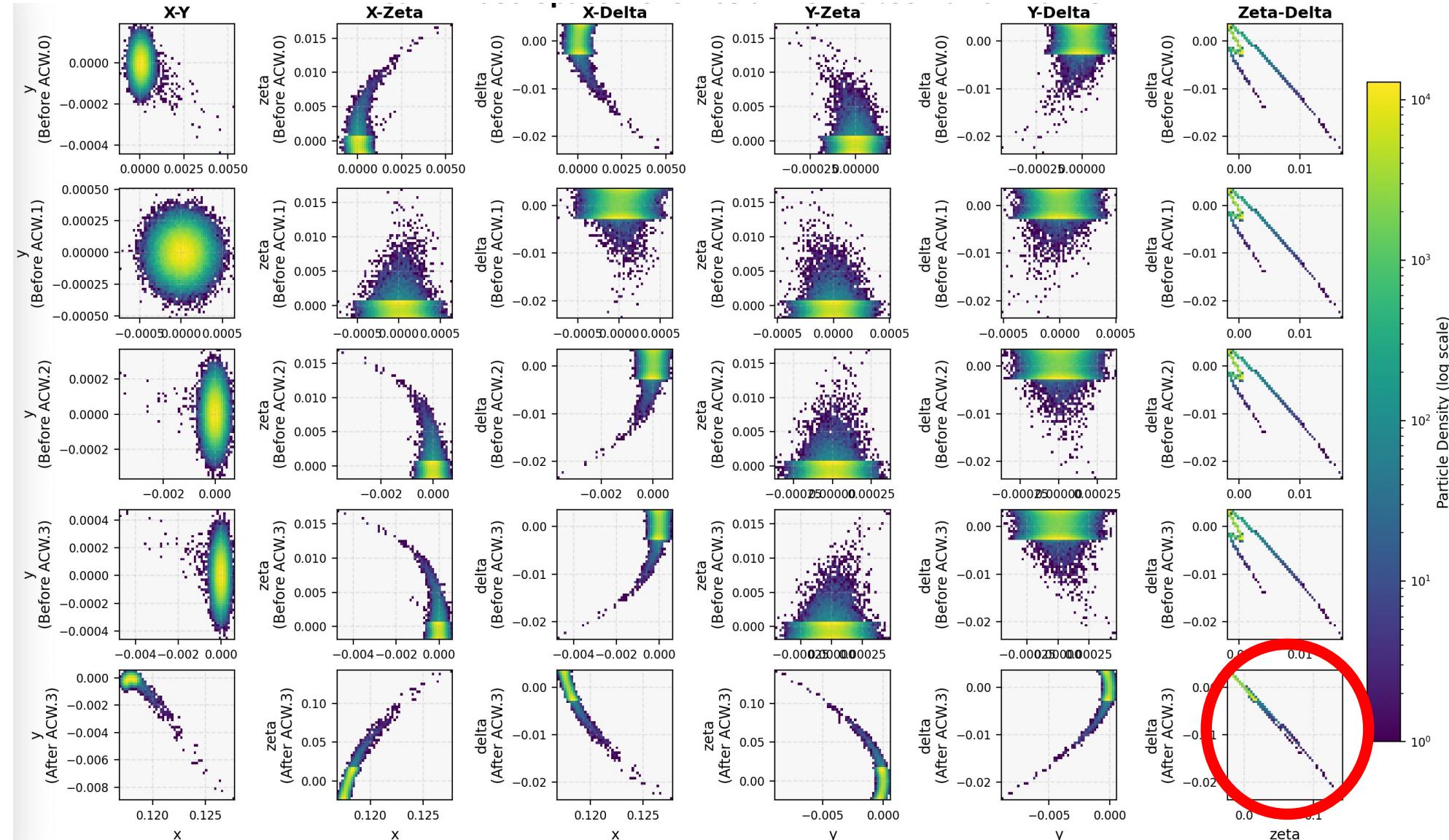
ECS Voltage=0, magnets unchanged

DA Overlays at Optimal Lag = 180.00 | Total Survival = 0.8107

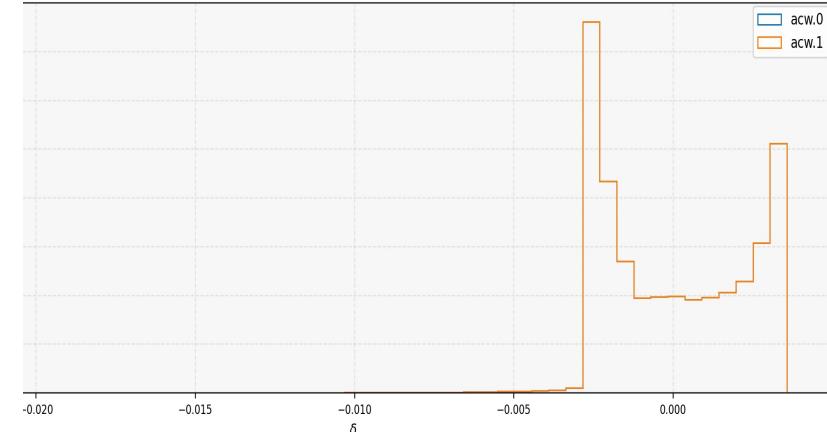
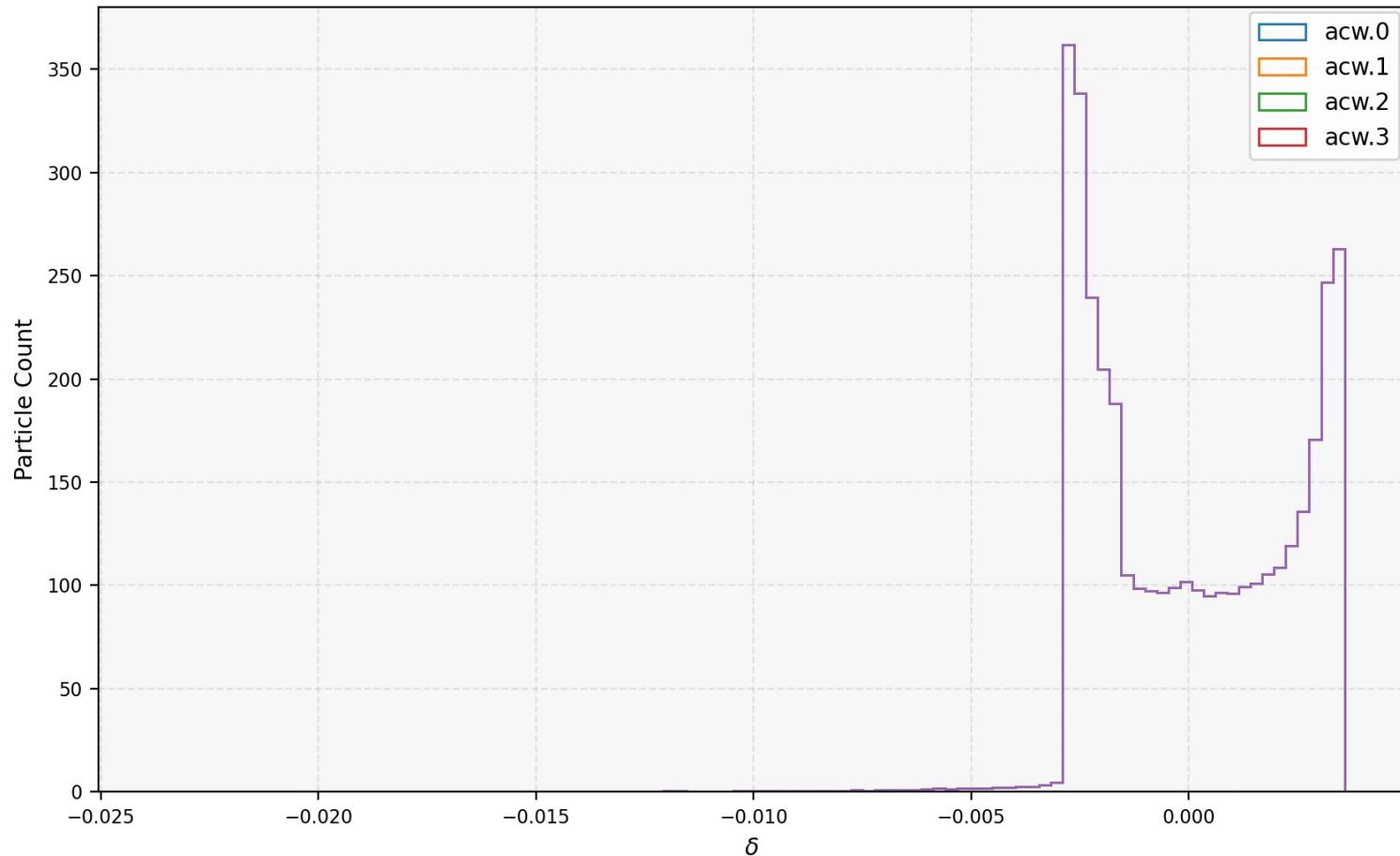


Reach ~81% acceptance into ring with ECS off

ECS Voltage=0, magnets unchanged



ECS off quads nominal



Delta remains unchanged along ECS. Difference is likely due to magnetic elements (nominal values)

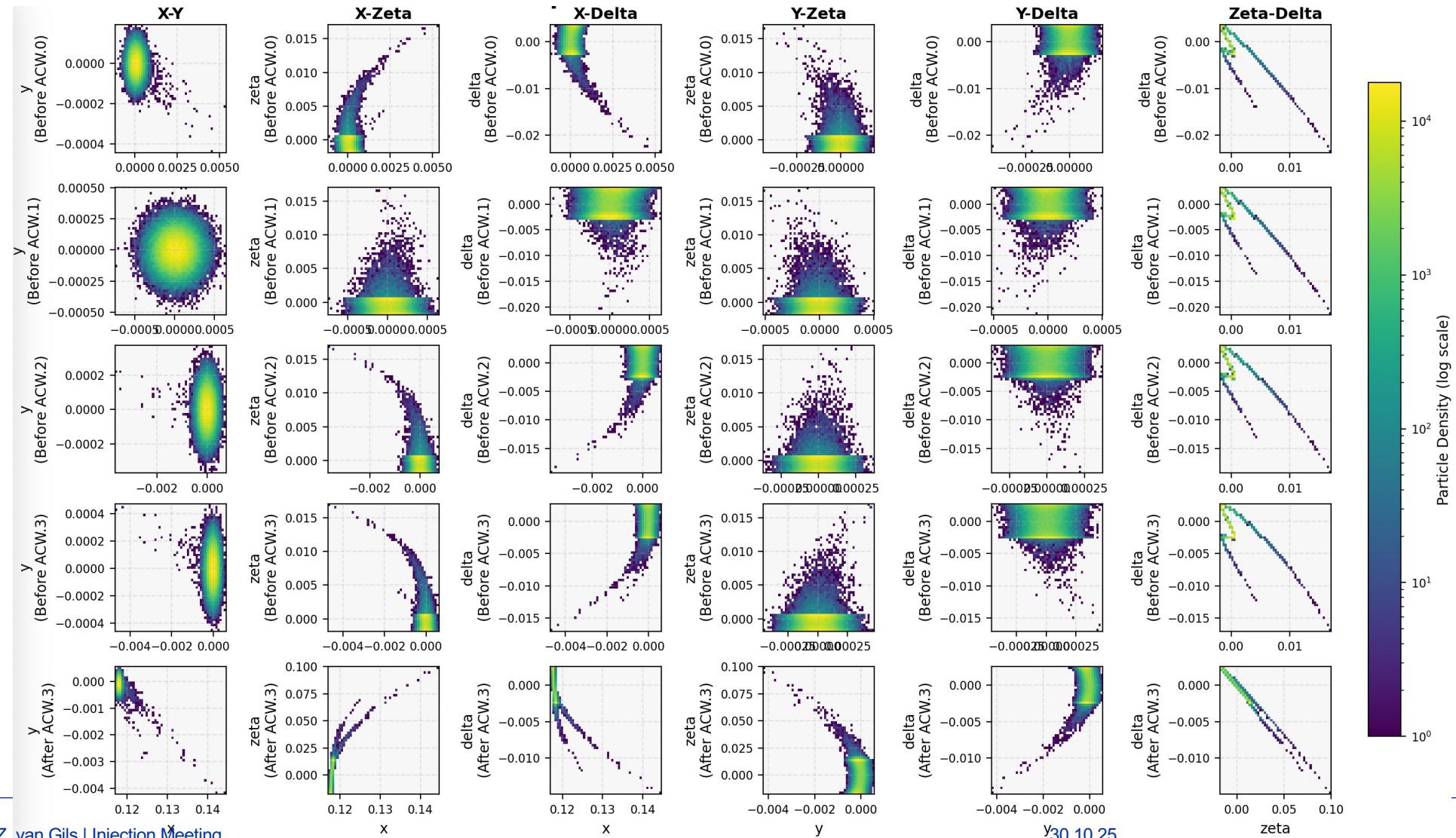
Purple: after acw.3

Some sanity checks

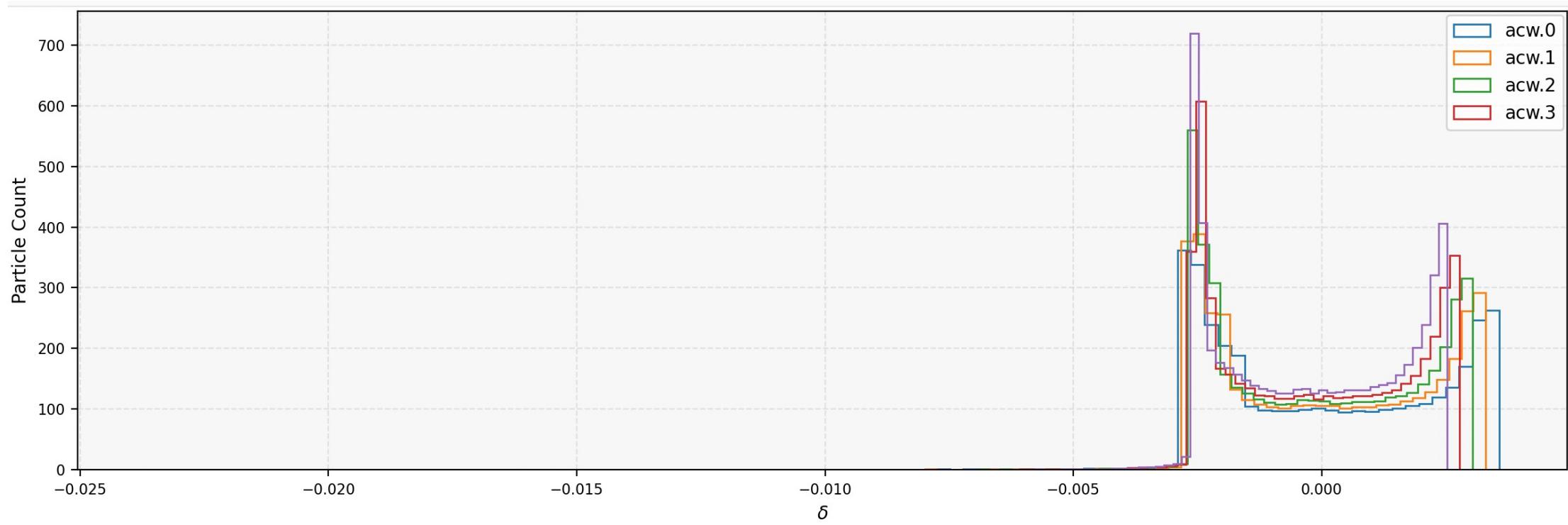
Does the ECS Voltage=0 cause any changes in delta? *Delta remains unchanged along ECS.*
Difference is likely in y due to magnetic elements (nominal values)

If we take the zero crossing (180 in Xsuite) does the bunch get shorter?

With the ECS on 18MV, zero crossing



With the ECS on 18MV, zero crossing



Indeed the bunch is being compressed along the ECS

Purple: after acw.3

Some sanity checks

Does the ECS Voltage=0 cause any changes in delta? *Delta remains unchanged along ECS. Difference is likely in y due to magnetic elements (nominal values)*

If we take the zero crossing (180 in Xsuite) does the bunch get shorter? *Yes, but tails also appear more populated.*



Tracking the beam to injection point and comparing to the HER MA/DA

HER MA/DA provided by Jack S. (Xsuite modelling of HER/LER)

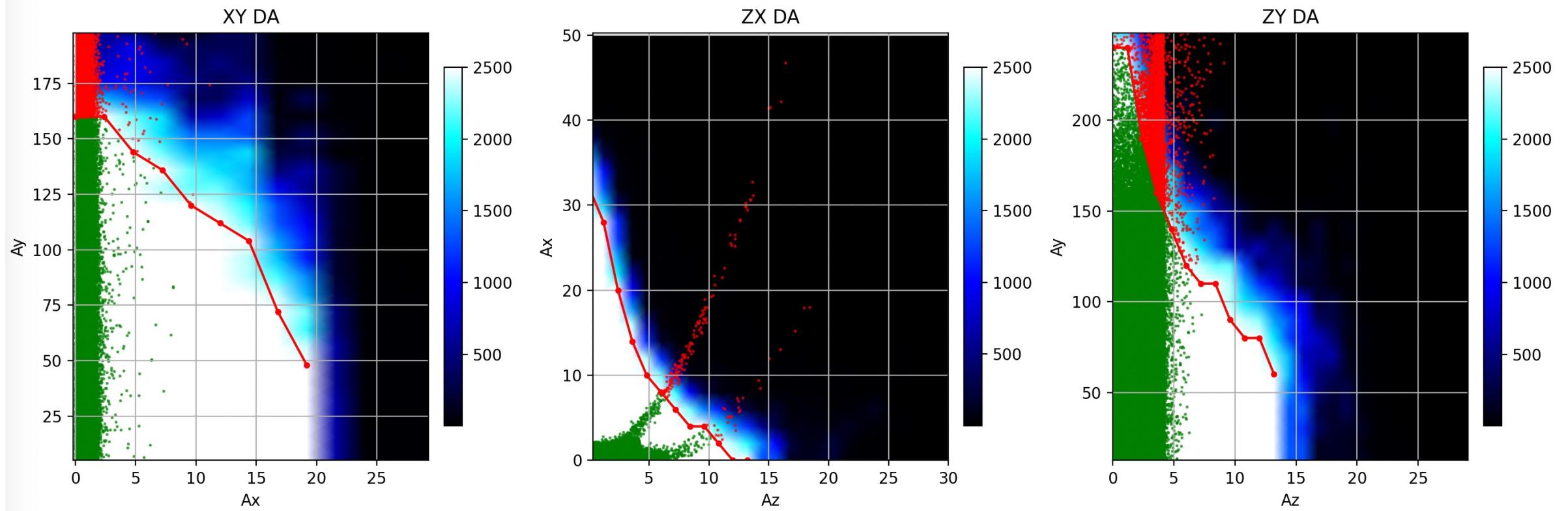
Very first estimate of injection efficiency (does not yet include septum - work in progress)

May need to be adjusted due to coordinate shifts... **very** preliminary

Tracking the beam and comparing to the HER MA/DA

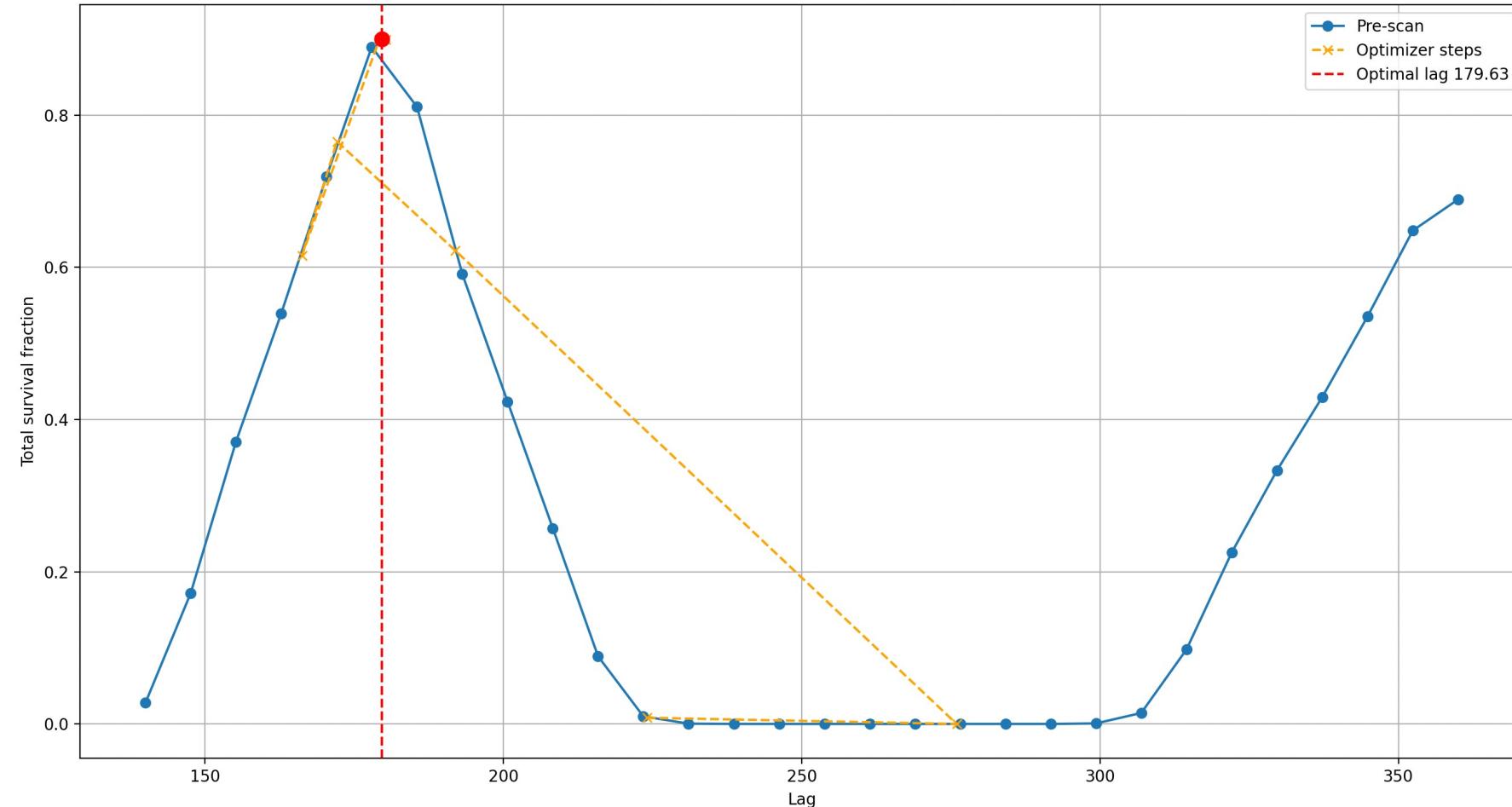
WORK IN PROGRESS

DA Overlays at Optimal Lag = 180.00 | Total Survival = 0.8999



→ To include: Septum in injection region

Optimisation: changes all four lags (at the same time) and checks survivability within DA/MA



Optimal at zero crossing (180) → another sanity check → we are happy

Next steps:

Implement septum in cut in order to make more clear comparison between injection beam and ring acceptance.

Do a 2D optimisation of ECS lag and voltage → what are the limits on the voltage?

Adjust for orbit due to different delta?



Comments/questions

Septum implementation: coordinate transformation required?

There is a COORD_ transformation in BTe (assumed to give coord transf. from BT to main ring?) but not BTp. Will have to check if this is sufficient to place septum in line. INJP=INJECTIO? But have no common point (or transformation) in BTp.

***2D optimisation of ECS sufficient (voltage+lag) or additional parameter to be added?
Require delta = 0 after ECS?***

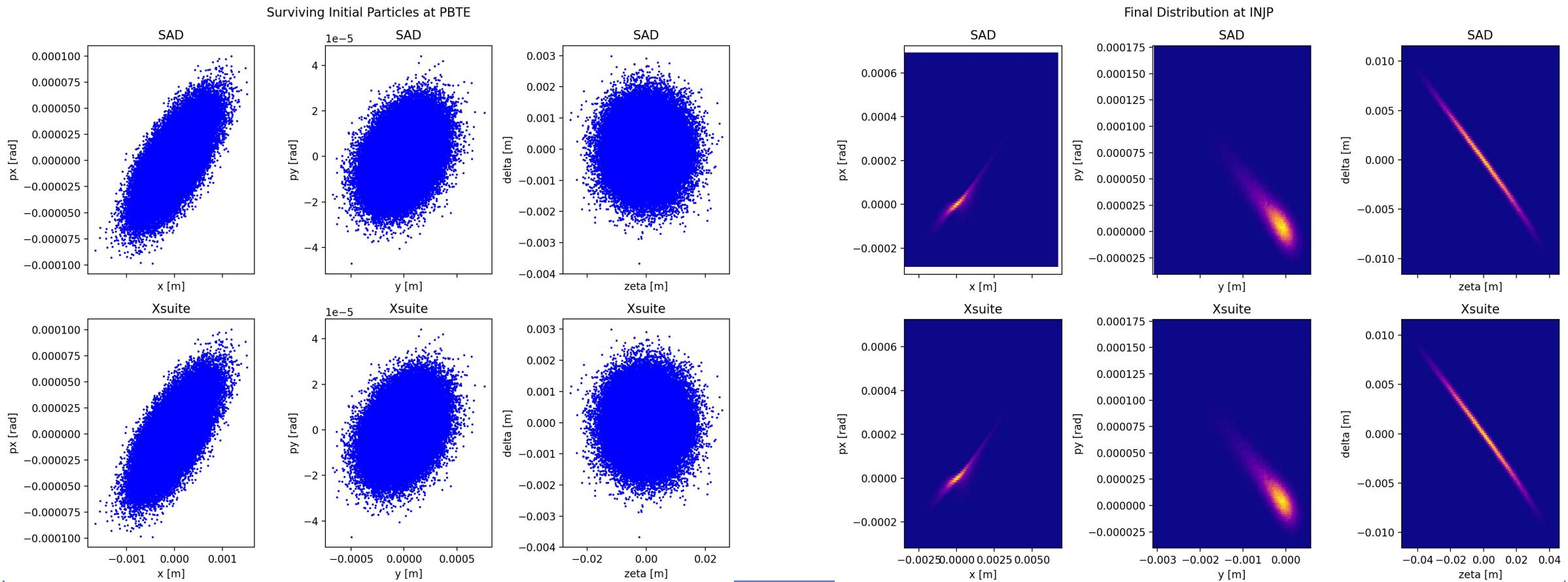
In operation ~100MV Voltage was used in ECS,

Bonus point: Optimisation with different lags for every cavity? (could help see if increasing number of powersupplies could be a good option)

Backup slides

BTe tracked lattices in Xsuite vs SAD

Comparison SAD/XSuite with Gaussian input beam into BTe



Off zero crossing lag 185 causes orbit of reference particle

